DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS

THE

BULLETIN

OF THE

BEACH EROSION BOARD

OFFICE, CHIEF OF ENGINEERS
WASHINGTON, D.C.

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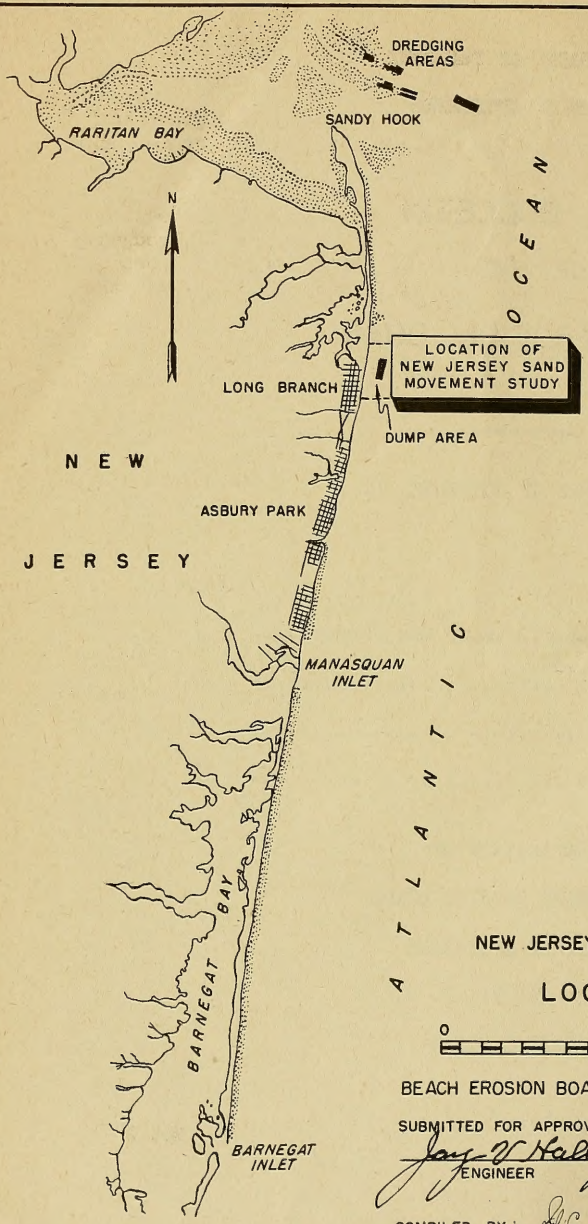

NEW JERSEY SAND MOVEMENT STUDY

LOCALITY MAP

0 10 20 MI.

BEACH EROSION BOARD, WASHINGTON, D.C., 17, DEC., 1948

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PLATE I

SAND MOVEMENT STUDY AT LONG BRANCH, N.J.

For some time engineers doing beach erosion and shore protection work have considered the practicability of nourishing eroded shorelines with material dredged from nearby harbors.

A cooperative study between the New York District and the Beach Erosion Board to test the feasibility of using the disposal of dredged material to nourish eroded shores in the vicinity of coastal harbors was authorized by the Chief of Engineers on 3 February 1948 to test the method.

Division of Work

The New York District dredged, transported and dumped about 600,000 cubic yards of suitable material in an area off the coast of Long Branch, New Jersey, and also provided for all navigation aids at the dump area. The Beach Erosion Board performed all surveys and other work necessary to determine the movement of the dumped material, and prepared reports on the experiment.

Location and Description of Project Area

The project area, comprising the city of Long Branch, New Jersey and vicinity, is located on the North Atlantic Coast of the United States about eleven miles south of Sandy Hook, the southern entrance point to New York harbor. The city of Long Branch is highly developed as a summer resort, and lies on a slight rise in the surrounding terrain at about elevation +40 feet. The terrain slopes seaward to an elevation of +20 feet and terminates at the crest of a timber bulkhead which retains Ocean Avenue. Immediately below the bulkhead is a relatively steep, narrow, yellow sand beach intersected by numerous heavy rubble mound groins. Crossing the beach seaward from the center of the city is a fishing and recreation pier 900 feet in length, which terminates in about 24 feet of water.

Northward from Long Branch the land lowers and extends to the north as a barrier beach which is less than 300 feet wide at its narrowest point. Along the greater part of this stretch of coast, the beach is backed by a high rubble mound seawall, designed to prevent storm waves from breaching the barrier.

The area covered by detailed studies in this investigation extends from the Long Branch fishing and recreation pier northward to Shrewsbury Rocks, which are seaward from the Monmouth Beach Coast Guard station. The dump area, 3700 feet long and 750 feet wide, lies about 1/2 mile from shore in 38 feet of water, with its southerly limit on an east-west line about 1500 feet north of the Long Branch pier.

Procedure

The Beach Erosion Board's Field Research Group No. 2 moved into the Long Branch area on 14 March 1948 and established their field office on city-owned land adjacent to the project area. The work of establishing control along four miles of beach, for the seventy profiles to be duplicated at intervals in order to trace sand movement, was started immediately. Sufficient hydrographic work had been completed to permit delineation of the dump area by mid-April.

Sand Dumping. The New York District hopper dredge "Goethals" dumped the first load of material, dredged from the New York channel, at the Long Branch site on 30 April 1948. Dumping at the site continued throughout the summer until 19 August 1948 when a grand total of 601,991 cubic yards of sand had been dumped along the shoreward side of the dump area.

Surveys. Prior to any dumping by the dredge a hydrographic survey was made of the area to serve as the basic survey. Surveys were made later of the dump area at about weekly intervals to determine the movement of the sand dumped by the dredge, and also to insure the safety of the dredge in operations over the dumping grounds. Comparative hydrographic surveys of the entire area were made at three-month intervals.

Sampling. Sand samples of the offshore bottom material were taken at selected locations, along with samples from the beach at mid-tide level. A sample of each dredge load was taken before dumping at the site.

Aerial Photographs. Aerial photographs of the shore line under study were flown by the U. S. Naval Reserve of Willow Grove, Pa. on 7 September and 16 October 1948.

Oceanographic Conditions during Test

Weather. During the period of study, 15 March to 9 November 1948, ocean and weather conditions were favorable to hydrographic operations 58% of the time. Adverse conditions, which included days of rain, fog, haze and heavy seas, were encountered 42% of the time. During this period storms of varied intensity visited the area. The first storm of consequence struck the north Jersey coast on 15 May 1948. Winds were from the northeast, 20 to 30 mph., with waves 6 to 8 feet in height. The highest tide of the season was recorded at this time with a maximum tide of 6.3 feet above mean low water. A second storm starting on 4 October and lasting through 6 October 1948 was of greater intensity. Winds were from the northeast with sustained velocities of 25 mph. and gusts up to 45 mph. Waves were from 10 to 15 feet in height with 8 to 10 second periods.

A third storm started 23 October 1948 and lasted for four days. Winds were again from the northeast with sustained velocities of 40 mph. and gusts up to 55 mph. Waves were 12 to 15 feet in height with periods of 10 to 15 seconds. A hurricane of strong intensity passed 300 miles to seaward of the area under study on 31 August 1948, and waves 5 to 6 feet in height were experienced along the Jersey coast as a result.

Waves and Swells. An examination of all wave data recorded by the Beach Erosion Board's wave gauge during the period of study showed average wave conditions to be as follows; severe storm wave - 12 foot height and 10 second period, moderate storm wave - 6 foot height and 8 second period, normal wave - 2 foot height and 6 second period.

Due to the configuration and bearing of the shore line and the shelter afforded by Long Island, only those open sea swells approaching from the northeast, east, southeast and south affect the area under study. Information, taken from a swell diagram for the ten-year period 1932 to 1942, showed that swells approached the beach from these directions 40.6% of the time; viz. swell heights of 1 to 6 feet - 36.8%, 6 to 12 feet - 2.5%, and over 12 feet - 1.3%.

Winds. Using a wind diagram constructed from wind data obtained by the United States Weather Bureau at Sandy Hook, New Jersey, it was concluded that onshore winds prevail 59% of the time.

Characteristics of the Sand

Seven sets of sand samples, totalling 320 samples, were taken over a five-month period. These were taken at 400 foot intervals, both along the beach and the profiles, to determine the character of the native materials. Mechanical analyses of these sand samples were made at the Beach Erosion Board's laboratory. Four composite samples were subjected to petrographic analysis to ascertain the existence of unique minerals which could be used as tracers. Distinctive criteria were lacking between the dredge, beach and bottom samples; neither geometric mean diameter nor mineralogical composition was a satisfactory criterion for determining sand movement in this case.

Comparative Dump Area Surveys

During the period 4 May to 27 October 1948, twenty-one surveys of the dump area were made and quantities computed by the end-area method. These computations showed that there had been 125,231 cubic yards or about 21% loss of material from the dumped area during the course of the study. The profiles as run over the dump area showed erosion over nearly all their length with accretion in the lower pockets, probably indicating a flattening of the dump pile. After all dumping had been completed there were three peaks on the dump area. The major material losses occurred on these peaks and on the steeper slopes; particularly on the seaward side.

Comparative Seasonal Surveys

Seasonal surveys made in April, July and October 1948 were used as a basis for determining changes in the position of the high-water shore line and the 12, 24, 30, 36 and 42-foot depth contours. The April survey was made prior to the first dump; the July survey near the end of the dumping period and the October survey after all dumping had been completed. The purpose of these surveys was to aid in detection of any realignment of the depth curves and shore line resulting from the movement of the dumped material.

An examination of the high-water shore line showed that in general accretion had taken place on the beach during the periods April-July and July-October, except during the latter period in the area north of the jettied section adjacent to the pier. Here there had been a general shifting of the sands with a relative balance between accretion and erosion. Seaward from the shore line, excluding the area where the dredged material had been deposited, there had been a general oscillatory shifting of the depth curves. The changes in shoreline and depth curves, exclusive of the dump area, do not show a detectable movement of the dumped material. Such changes as did occur are considered to be the result of natural seasonal changes in oceanographic conditions.

Discussion

An examination of all waves recorded during the course of the study, including the three severe storms, showed average waves available to move the sand to be 12-foot waves of 10-second period, 6-foot waves of 8 second period, and 2-foot waves of 6-second period. The bottom orbital velocities for these waves were computed for two depths; 40-feet at the seaward toe of the pile and 28-feet as the minimum depth at the crest of the pile. These velocities, applied to Filip Hjulstrom's curve "Lower Limit of Eroding Velocities" with a graph of the sand particle size distribution of the dumped material, show that in all but one instance (velocity of the 2-foot wave with 6-second period over a 40-foot depth) wave velocities were sufficient to erode material from the bottom. However these eroding forces on the bottom are not unidirectional but oscillatory.

In view of the nature of these forces and the assumption that other transporting forces are extremely weak or even non-existent, it is believed that the sand will merely be shifted about, filling the depressions and flattening the pile in general. That this action did occur was confirmed by an examination of the comparative dump area profiles covering the period after all dumping had been completed to the date of the final survey of the study.

During the period of study between April and October 1948, 125,231 cubic yards of material were eroded from the pile. This amounts to only 21% of the material dumped. As an examination of the comparative seasonal surveys did not show a mass movement of the material, the reasonable assumption has been made that the material eroded from the pile has been scattered in a thin layer over a wide area.

Conclusion

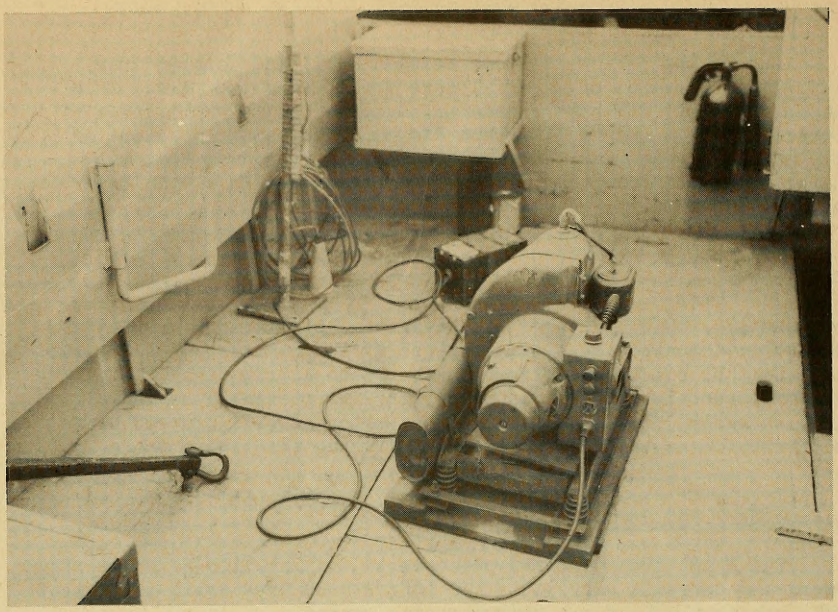
As 476,760 cubic yards or 79% of the total dredge bin measure dumped at the site was still in place at the conclusion of the study and since no beneficial effect on the beach attributable to the dumped material has been observed, there is presently no indication that shoreward movement of the dumped material will proceed at a sufficient rate to be of value in nourishing the eroded shore.

Future Work and Study

The Beach Erosion Board proposes to continue its wave observations and periodic surveys in the Long Branch area until sufficient data are available for a comprehensive report.

* * *

Resume of a report prepared by J. V. Hall, Chief of Field Research Group, Beach Erosion Board.



CARGO DECK OF "DUCK" SHOWING GENERATOR,
TRANSFORMER, AND LIGHT MOUNTING

MERCURY VAPOR LAMP INSTALLED ON "DUCK"

FIG. 1

SURVEYING IN HAZE AND FOG

The Field Research Group of the Beach Erosion Board has been conducting littoral drift studies on the coast of California at Anaheim and Santa Monica Bays. Throughout the conduct of these investigations it was necessary to follow a strict schedule for hydrographic survey operations in order to meet the work schedule. Standard survey methods employed by this group had to be modified in order to permit operations during periods of poor visibility created by haze and fog. Several expedients which would increase the range of visibility of the instrument-men were tried, but only one method showed enough promise to warrant its continued use. This entailed the installation on the sounding craft of a high intensity mercury vapor lamp that would be visible from shore during the frequent periods of haze and fog.

This equipment consisted of a 220 volt, 60 cycle, 1600 lumen mercury vapor lamp with a 400 volt-ampere, 110-220 volt autotransformer. A $1\frac{1}{2}$ kilovolt-ampere generator, driven by a gasoline engine, was provided as the source of power for the lamp. The sounding craft on which the installation was made was an Army $2\frac{1}{2}$-ton amphibian truck (commonly known as a "Duck"). Accompanying photographs show the location of this equipment aboard the "Duck." Reasonable protection, such as a canvas tarpaulin, had to be provided for the transformer and generator to shield it from salt water spray. The lamp itself required no additional protection as it is constructed of two concentric pyrex tubes, the outer tube protecting the hot inner tube from breaking due to contact with sea spray.

This equipment, exclusive of the generator unit, can be procured and installed for a cost outlay of about $50.00. If a suitable power source is not available on the sounding craft, a portable generator unit similar to the one described in this article can be bought for about $350.00.

When the apparatus was installed, a number of tests were made which showed that the use of the lamp increased the range of working visibility by fifty to seventy-five percent. The Field Research Group of the Beach Erosion Board has used the equipment during hydrographic survey operations extending over a period of several months, and during this period it is estimated that time lost due to haze and fog has been reduced by fifty percent.

BEACH EROSION STUDIES

The principal types of beach erosion reports of studies at specific localities are the following:

a. Cooperative studies (authorization by the Chief of Engineers in accordance with Section 2, River and Harbor Act approved on 3 July 1930).

b. Preliminary examinations and surveys (Congressional authorization by reference to locality by name).

c. Reports on shore line changes which may result from improvements of the entrances at the mouths of rivers and inlets (Section 5, Public Law No. 409, 74th Congress).

d. Reports on shore protection of Federal property (authorization by the Chief of Engineers).

Of these types of studies, cooperative beach erosion studies are the type most frequently made when a community desires investigation of its particular problem. As these studies have, consequently, greater general interest, information concerning studies of specific localities contained in these quarterly bulletins will be confined to cooperative studies. Information about other types of studies can be obtained upon inquiry to this office.

Cooperative studies of beach erosion are studies made by the Corps of Engineers in cooperation with appropriate agencies of the various States by authority of Section 2 of the River and Harbor Act approved on 3 July 1930. By executive ruling the cost of these studies is divided equally between the United States and the cooperating agency. Information concerning the initiation of a cooperative study may be obtained from any District Engineer of the Corps of Engineers. After a report on a cooperative study has been transmitted to Congress, a summary thereof is included in the next issue of this bulletin. A list of cooperative studies now in progress follows.

COOPERATIVE BEACH EROSION STUDIES IN PROGRESS

NEW HAMPSHIRE

HAMPTON BEACH. Cooperating Agency: New Hampshire Shore and Beach Preservation and Development Commission.

Problem: To determine the best method of preventing further erosion and of stabilizing and restoring the beaches; also to determine the extent of silting and erosion in the harbor.

MASSACHUSETTS

METROPOLITAN DISTRICT BEACHES, BOSTON. Cooperating Agency; Metropolitan District Commission (for the Commonwealth of Massachusetts).

Problem: To determine the best methods of preventing further erosion, of stabilizing and improving the beaches, and of protecting the sea walls of Lynn Shore Reservation, Nahant Beach Parkway, Revere Beach, Quincy Shore, Nantasket Beach.

SALISBURY BEACH. Cooperating Agency: Department of Public Works (for the Commonwealth of Massachusetts).

Problem: To determine the best methods of preventing further beach erosion. This will be a final report to report dated 26 August 1941.

CONNECTICUT

STATE OF CONNECTICUT. Cooperating Agency: State of Connecticut (Acting through the Flood Control and Water Policy Commission).

Problem: To determine the most suitable methods of stabilizing and improving the shore line. Sections of the coast will be studied in order of priority as requested by the cooperating agency until the entire coast is included.

NEW JERSEY

ATLANTIC CITY. Cooperating Agency: City of Atlantic City.

Problem: To determine the best methods of preventing further beach erosion.

OCEAN CITY. Cooperating Agency: City of Ocean City.

Problem: To determine the causes of erosion or accretion and the effect of previously constructed groins and structures, and to recommend remedial measures to prevent further erosion and to restore the beaches.

VIRGINIA

VIRGINIA BEACH. Cooperating Agency: Town of Virginia Beach.

Problem: To determine methods for the improvement and protection of the beach and existing concrete sea wall.

SOUTH CAROLINA

STATE OF SOUTH CAROLINA. Cooperating Agency: State Highway Department.

Problem: To determine the best method of preventing erosion, stabilizing and improving the beaches.

LOUISIANA

LAKE PONTCHARTRAIN. Cooperating Agency: Board of Levee Commissioners, Orleans Levee District.

Problem: To determine the best method of effecting necessary repairs to the existing sea wall and the desirability of building an artificial beach to provide protection to the wall and also to provide additional recreational beach area.

TEXAS

GALVESTON COUNTY. Cooperating Agency: County Commissioners Court of Galveston County.

Problem: To determine the best method of providing a permanent beach and the necessity for further protection or extending the sea wall within the area bounded by the Galveston South Jetty and Eight Mile Road.

CALIFORNIA

STATE OF CALIFORNIA. Cooperating Agency: Division of Beaches and Parks, State of California.

Problem: To conduct a study of the problems of beach erosion and shore protection along the entire coast of California. The initial studies are to be made in the Ventura-Port Hueneme area and the Santa Monica area.

ILLINOIS

STATE OF ILLINOIS. Cooperating Agency: Department of Public Works and Buildings, Division of Waterways, State of Illinois.

Problem: To determine the best method of preventing further erosion and of protecting the Lake Michigan shore line within the Illinois boundaries.

OHIO

STATE OF OHIO. Cooperating Agency: State of Ohio (Acting through the Superintendent of Public Works).

Problem: To determine the best method of preventing further erosion of and stabilizing existing beaches, of restoring and creating new beaches, and appropriate locations for the development of recreational facilities by the State along the Lake Erie shore line.

PENNSYLVANIA

PRESQUE ISLE. Cooperating Agency: State Parks and Harbor Commission of Erie (for the Commonwealth of Pennsylvania).

Problem: To determine the best method of preventing further erosion and stabilizing the beaches of Presque Isle Peninsula at Erie, Pennsylvania. This will be a supplemental report to the report dated 3 April 1942.

Cooperative study on Colonial Beach, Va., formerly reported, has been completed but not yet submitted to Congress. The Hancock County, Miss., cooperative study has been cancelled at the request of local authorities.

The following reports have been published as House Documents and are available to interested parties.

Winthrop Beach, Mass., State of North Carolina, Palm Beach, Fla., Jupiter Island, Fla., Anna Maria and Longboat Keys, Fla., Harrison Co., Miss., and Punta Las Marias, San Juan, P. R.

BEACH EROSION LITERATURE

There are listed below some recent acquisitions of the Board's library which are considered to be of general interest. Copies of these publications can be obtained on 30-day loan by interested official agencies.

"An Investigation of the Energy Dissipated in a Surface Roller," G. A. Oosterholt, Appl. Sci. Res., Vol. A1, pp. 107-130.

This paper deals with the problem of the dissipation of energy in hydraulic jumps. Description is given of experiments and computations to determine the quantity of energy converted into heat per cubic centimeter and per second in a surface roller. The results probably can be made to apply to other cases of similar flow, such as eddies and wakes.

"Diffraction of Water Waves by Breakwaters," J. A. Putman and R. S. Arthur, Scripps Institution of Oceanography, Wave Report No. 67.

Application is made of a solution of the water-wave diffraction problem of Penny and Price to diffraction by a semi-infinite impermeable breakwater. Approximations are introduced to simplify application of the theory. Comparison of complete and simplified solutions is made with results obtained from a laboratory investigation. Best agreement between theory and experiment occurred in the lee of the breakwater. The simplified solution is shown to be adequate for most practical applications.

"Coastal Water Circulation off the East Coast of the United States between Cape Hatteras and Florida," D. F. Bumpus and T. J. Wehe, Technical Report No. 16 on the Hydrography of the Western Atlantic, Woods Hole Oceanographic Institution, January 1949, 9 pp., diagrams.

This paper discusses water circulation in the area inshore of the Gulf Stream, with information on surface temperature, salinity and density. Within this area a theory is postulated of one elongated cyclonic movement and possibly several smaller eddies occupying the coastal shelf.

"The Equatorial Currents of the Eastern Pacific as Maintained by the Stress of the Wind," Robert O. Reid, Scripps Institution of Oceanography, Oceanographic Report No. 11.

Ignoring lateral friction and thermodynamic processes, this paper verifies that, in the eastern equatorial Pacific, the predominant features of the distribution of mass and of mass transport of water can be accounted for semi-quantitatively in terms of the wind stress alone. It is concluded that the longitudinal mass transport increases nearly linearly with distance from the continent, while the north-south transport is practically independent of longitude and is a maximum very near the boundaries of the countercurrent.

"Recent Shoreline Changes at Shirley Gut, Boston Harbor," Robert L. Nichols, The Journal of Geology, Vol. 57-No. 1, Jan. 1949, pp. 85-89, 4 diagrams.

The history of Shirley Gut and analysis of the physiographic processes causing its closing and joining of Deer Island to the mainland are briefly presented.

"Annual Variations in Current Speeds in the Gulf Stream System," Frederick C. Fuglister, Technical Report No. 15 on the Hydrography of the Western Atlantic, Woods Hole Oceanographic Institution, November 1948, 10 pp., diagrams and Tables.

"The purpose of this paper is to show that the many hundreds of surface current observations on file at the U. S. Navy Hydrographic Office also give what appears to be a consistent picture of annual variations in the current speeds in various segments of the Gulf Stream System. ---" The Gulf Stream System is divided into ten segments, and annual current speed variation from observed data and as calculated from harmonic analysis with a combination of annual and semiannual periods are compared. The comparison is carried further between variation in current speed and component of wind in the direction of the current, and current speed variation and tide gauge records.